

AMENDMENTS TO THE SPECIFICATION

Please replace the Title of the specification with the following:

**INFORMATION CODING APPARATUS, INFORMATION DECODING
APPARATUS, AND METHOD AND PROGRAM FOR THE SAME**

Please insert the following paragraph after the Title on page 1 of the specification:

This application is a National Stage of PCT/JP2004/005090, filed April 8, 2004 and claims priority on Japanese Patent Application No. 2003-104048, filed on April 8, 2003. The disclosure of the above applications are incorporated herein by reference.

Please replace Paragraph [0012] with the following paragraph rewritten in amendment format:

[0012] This invention is made in order to solve the above-described problems; and an information coding apparatus according to the present invention comprises a code block conversion unit which codes information bits which are inputted as a block of a two-dimensional image made up from m (where m is a natural number) $\times n$ (where n is a natural number) pixels, wherein the code block conversion unit arranges pixels which represent the information bits in a code area, which is an area of $(m - o) \times (n - p)$ pixels within a code block of $m \times n$ pixels (where o and p are natural numbers which satisfy $0 < o < m$ and $0 < p < n$); and arranges no pixels which represent the

information bits in a guide area, which is an area ~~of the other pixels other than the code area~~ within the code block of $m \times n$ pixels.

Please replace Paragraph [0013] with the following paragraph rewritten in amendment format:

[0013] Furthermore, an information coding apparatus according to the present invention comprises a code block conversion unit which codes information bits which are inputted as a block of a two-dimensional image made up from m (where m is a natural number) $\times n$ (where n is a natural number) pixels, wherein the code block conversion unit arranges pixels which represent the information bits in a code area, which is an area of $(m - o) \times (n - p)$ pixels within a code block of $m \times n$ pixels (where o and p are natural numbers which satisfy $0 < o < m$ and $0 < p < n$); and arranges pixels which represent predetermined information bits in a guide area, which is an area ~~of the other pixels other than the code area~~ within the code block of $m \times n$ pixels.

Please replace Paragraph [0014] with the following paragraph rewritten in amendment format:

[0014] Furthermore, in the above-described information coding apparatuses, the code block conversion unit may determine the size and the position of a pixel representing the information bits which is arranged in the code area which is the area of $(m - o) \times (n - p)$ pixels, based upon the size of the code area of $(m - o) \times (n - p)$ pixels so that the pixel which represents the information bits is completely included in the code area.

Please replace Paragraph [0015] with the following paragraph rewritten in amendment format:

[0015] Furthermore, an information decoding apparatus according to the present invention comprises: a code pattern estimation unit which receives input of a photographed image which has been obtained by photographing a two-dimensional image which consists of an area of $m \times n$ pixels with an imaging device, in which a single code block comprises a code area in which $(m - o) \times (n - p)$ pixels which represent information bits (where m and n are natural numbers, and o and p are natural numbers which satisfy $0 < o < m$ and $0 < p < n$) are arranged, and a guide area in which no pixels which represent the information bits are arranged, and which estimates a code pattern of the code block based upon the result of relative comparison between the photographed image and ideal photographed images in an ideal state which are calculated based upon the positional relationship between the two-dimensional image and the imaging device; and a bit string reconstruction unit which decodes the information bits corresponding to each code block of the photographed image which is inputted based upon the result of the estimation of the pattern.

Please replace Paragraph [0016] with the following paragraph rewritten in amendment format:

[0016] Furthermore, in the above-described information decoding apparatus, there may be further included: a positional deviation amount detection unit which detects an amount of positional deviation between pixels

of the two-dimensional image and pixels of an imaging device, based upon the photographed image which has been photographed by the imaging device; an ideal photographed image calculation unit which calculates ideal photographed images of code blocks which are photographed by the imaging device corresponding to all the code patterns based upon the amount of positional deviation which has been detected; and an image comparison unit which compares together the photographed image which is inputted and the ideal photographed images which have been calculated, and calculates relative values, and wherein the code pattern estimation unit estimates the code pattern of the code block from the relative values which have been calculated.

Please replace Paragraph [0017] with the following paragraph rewritten in amendment format:

[0017] Furthermore, in the above-described information decoding apparatus, there may be further included: a positional deviation amount detection unit which detects an amount of positional deviation between pixels of the two-dimensional image and pixels of the imaging device, based upon the photographed image which has been photographed by the imaging device; an ideal photographed image calculation unit which calculates ideal photographed images of code blocks which are photographed by the imaging device corresponding to all the code patterns based upon the amount of positional deviation which has been detected; an ideal reconstructed image calculation unit which calculates ideal reconstructed images of code blocks

corresponding to all the code patterns based upon the ideal photographed images which have been calculated, and the amount of positional deviation which has been detected; a reconstructed image calculation unit which calculates a reconstructed image of the two-dimensional image from the photographed image, based upon the amount of positional deviation which has been detected; and an image comparison unit which compares together the reconstructed image which has been calculated from the photographed image and the ideal reconstructed images which have been calculated from the code blocks, and calculates relative values, and wherein the code pattern estimation unit may estimate the code pattern of the code block from the relative values which have been calculated.

Please replace Paragraph [0018] with the following paragraph rewritten in amendment format:

[0018] Furthermore, an information coding method according to the present invention codes information bits which are inputted as a block of a two-dimensional image made up from m (where m is a natural number) $\times n$ (where n is a natural number) pixels, and the method comprises the steps of: arranging pixels which represent the information bits in a code area, which is an area of $(m - o) \times (n - p)$ pixels within a code block of $m \times n$ pixels (where o and p are natural numbers which satisfy $0 < o < m$ and $0 < p < n$); and arranging no pixels which represent the information bits in a guide area, which is an area of ~~the other pixels other than the code area~~ within the code block of $m \times n$ pixels.

Please replace Paragraph [0019] with the following paragraph rewritten in amendment format:

[0019] Furthermore, an information coding method according to the present invention codes information bits which are inputted as a block of a two-dimensional image made up from m (where m is a natural number) $\times n$ (where n is a natural number) pixels, and the method comprises the steps of: arranging pixels which represent the information bits in a code area, which is an area of $(m - o) \times (n - p)$ pixels within a code block of $m \times n$ pixels (where o and p are natural numbers which satisfy $0 < o < m$ and $0 < p < n$), and arranging pixels which represent predetermined information bits in a guide area, which is an area ~~of the other pixels other than the code area~~ within the code block of $m \times n$ pixels.

Please replace Paragraph [0020] with the following paragraph rewritten in amendment format

[0020] Furthermore, in the above-described information coding methods, the size and the position of a pixel representing the information bits which is arranged in the code area which is the area of $(m - o) \times (n - p)$ pixels may be determined based upon the size of the code area of $(m - o) \times (n - p)$ pixels so that the pixel which represents the information bits is completely included in the code area.

Please replace Paragraph [0021] with the following paragraph rewritten in amendment format:

[0021] Furthermore, the information decoding method according to the present invention comprises the steps of: receiving input of a photographed image which has been obtained by photographing a two-dimensional image which consists of an area of $m \times n$ pixels with an imaging device, in which a single code block comprises a code area in which $(m - o) \times (n - p)$ pixels which represent information bits (where m and n are natural numbers, and o and p are natural numbers which satisfy $0 < o < m$ and $0 < p < n$) are arranged, and a guide area in which no pixels which represent the information bits are arranged; estimating a pattern of the code block based upon the result of relative comparison between the photographed image and ideal photographed images in an ideal state which are calculated based upon the positional relationship between the two-dimensional image and the imaging device; and decoding the information bits corresponding to each code block of the photographed image which is inputted based upon the result of the estimation of the pattern.

Please replace Paragraph [0022] with the following paragraph rewritten in amendment format:

[0022] Furthermore, the above-described information decoding method may further comprise the steps of: detecting an amount of positional deviation between pixels of the two-dimensional image and pixels of the imaging device, based upon the photographed image which has been photographed by the imaging device; calculating ideal photographed images of code blocks which are photographed by the imaging device corresponding

to all the code patterns based upon the amount of positional deviation which has been detected; comparing together the photographed image which is inputted and the ideal photographed images which have been calculated, and calculating relative values; and estimating the code pattern of the code block from the relative values which have been calculated.

Please replace Paragraph [0023] with the following paragraph rewritten in amendment format:

[0023] Furthermore, the above-described information decoding method may further comprise the steps of: detecting an amount of positional deviation between pixels of the two-dimensional image and pixels of the imaging device, based upon the photographed image which has been photographed by the imaging device; calculating ideal photographed images of code blocks which are photographed by the imaging device corresponding to all the code patterns based upon the amount of positional deviation which has been detected; calculating ideal reconstructed images of all the code blocks corresponding to all the code patterns based upon the ideal photographed images which have been calculated, and the amount of positional deviation which has been detected; calculating a reconstructed image of the two-dimensional image from the photographed image based upon the amount of positional deviation which has been detected; comparing together the reconstructed image which has been calculated from the photographed image and the ideal reconstructed images which have been calculated from the code blocks, and calculating relative values; and

estimating the code pattern of the code block from the relative values which have been calculated.

Please replace Paragraph [0024] with the following paragraph rewritten in amendment format:

[0024] An information coding program according to the present invention is an information coding program which causes a computer to execute a coding process of coding information bits which are inputted as a block of a two-dimensional image made up from m (where m is a natural number) $\times n$ (where n is a natural number) pixels, the coding process comprising the steps of: arranging pixels which represent the information bits in a code area, which is an area of $(m - o) \times (n - p)$ pixels within a code block of $m \times n$ pixels (where o and p are natural numbers which satisfy $0 < o < m$ and $0 < p < n$); and arranging no pixels which represent the information bits in a guide area, which is an area of ~~the other pixels~~ other than the code area within the code block of $m \times n$ pixels.

Please replace Paragraph [0025] with the following paragraph rewritten in amendment format:

[0025] Furthermore, an information coding program according to the present invention is an information coding program which causes a computer to execute a coding process of coding information bits which are inputted as a block of a two-dimensional image made up from m (where m is a natural number) $\times n$ (where n is a natural number) pixels, the coding process

comprising the steps of: arranging pixels which represent the information bits in a code area, which is an area of $(m - o) \times (n - p)$ pixels within a code block of $m \times n$ pixels (where o and p are natural numbers which satisfy $0 < o < m$ and $0 < p < n$); and arranging pixels which represent predetermined information bits in a guide area, which is an area ~~of the other pixels~~ other than the code area within the code block of $m \times n$ pixels.

Please replace Paragraph [0026] with the following paragraph rewritten in amendment format:

In the coding process, the size and the position of a pixel representing the information bits which is arranged in the code area which is the area of $(m - o) \times (n - p)$ pixels may be determined based upon the size of the code area of $(m - o) \times (n - p)$ pixels so that the pixel which represents the information bits is completely included in the code area.

Please replace Paragraph [0027] with the following paragraph rewritten in amendment format:

[0027] An information decoding program according to the present invention causes a computer to execute: a process of receiving input of a photographed image which has been obtained by photographing a two-dimensional image which consists of an area of $m \times n$ pixels with an imaging device, in which a single code block comprises a code area in which $(m - o) \times (n - p)$ pixels which represent information bits (where m and n are natural numbers, and o and p are natural numbers which satisfy $0 < o < m$ and $0 < p < n$)

are arranged, and a guide area in which no pixels which represent the information bits are arranged, and of estimating a pattern of the code block based upon the result of relative comparison between the photographed image and ideal photographed images in an ideal state which are calculated based upon the positional relationship between the two-dimensional image and the imaging device; and a process of decoding the information bits corresponding to each code block of the photographed image which is inputted based upon the result of the estimation of the pattern.

Please replace Paragraph [0028] with the following paragraph rewritten in amendment format:

[0028] In the above described information coding program, the computer may be further caused to execute: a process of detecting an amount of positional deviation between pixels of the two-dimensional image and pixels of the imaging device, based upon the photographed image which has been photographed by the imaging device; a process of calculating ideal photographed images of code blocks which are photographed by the imaging device corresponding to all the code patterns based upon the amount of positional deviation which has been detected; a process of comparing together the photographed image which is inputted and the ideal photographed images which have been calculated, and calculating relative values; and a process of estimating the pattern of the code block from the relative values which have been calculated.

Please replace Paragraph [0029] with the following paragraph rewritten in amendment format:

[0029] In the above described information coding program, the computer may further be caused to execute: a process of detecting an amount of positional deviation between pixels of the two-dimensional image and pixels of the imaging device, based upon the photographed image which has been photographed by the imaging device; a process of calculating ideal photographed images of code blocks which are photographed by the imaging device corresponding to code patterns based upon the amount of positional deviation which has been detected; a process of calculating ideal reconstructed images of code blocks corresponding to all the code patterns based upon the ideal photographed images which have been calculated, and the amount of positional deviation which has been detected; a process of calculating a reconstructed image of the two-dimensional image from the photographed image based upon the amount of positional deviation which has been detected; a process of comparing together the reconstructed image which has been calculated from the photographed image and the ideal reconstructed images which have been calculated from the code blocks, and calculating relative values; and a process of estimating the code pattern of the code block from the relative values which have been calculated.

Please replace Paragraph [0034] with the following paragraph rewritten in amendment format:

[0034] Furthermore, the present invention calculates the amount of positional deviation between the pixels of the two-dimensional image and the pixels of ~~the photographed image~~ the imaging device is detected, calculates the ideal photographed image of a code block corresponding to a code pattern based upon the amount of positional deviation which has been detected, compares together the photographed image which is inputted and the ideal photographed image which has been calculated, calculates the relative value, and estimates the pattern of the code block from the relative value which has been calculated. Accordingly, it is possible to estimate the recorded code pattern, and it is possible to decode the information which has been coded at high density with good efficiency.

Please replace Paragraph [0035] with the following paragraph rewritten in amendment format:

[0035] Furthermore, the present invention detects the amount of positional deviation between the pixels of the two-dimensional image and the pixels of ~~the photographed image~~ the imaging device, calculates the ideal photographed image of a code block corresponding to a code pattern based upon the amount of positional deviation which has been detected, calculates the ideal reconstructed image of the code block based upon the ideal photographed image which has been calculated, and the amount of positional deviation which has been detected, calculates the reconstructed image of the two-dimensional image from the photographed image based upon the amount of positional deviation which has been detected, compares together the

reconstructed image which has been calculated from the photographed image and the reconstructed image which has been calculated from the code block, calculates the relative value; and estimates the pattern of the code block from the relative value which has been calculated. Accordingly, it is possible to estimate the recorded code pattern, and it is possible to decode the information which has been coded at high density with better efficiency.

Please replace Paragraph [00118] with the following paragraph rewritten in amendment format:

[00118] The positional deviation amount detection section 7-3 detects the amount of positional deviation between the two-dimensional image which has been coded and the ~~photographed image 7-1~~ imaging device.

Please replace Paragraph [00123] with the following paragraph rewritten in amendment format:

[00123] In other words, when a photographed image 7-1 of a two-dimensional image which has been coded is inputted to the decoding apparatus 7-2a, first, the amount of positional deviation between the two-dimensional image and the ~~photographed image~~ imaging device is detected by the positional deviation amount detection section 7-3. Next: ideal photographed images are calculated by the ideal photographed image calculation section 7-4 based upon the amount of positional deviation which has been detected; these ideal photographed images which have been calculated and the actual photographed image 7-1 are compared together by

the image comparison section 7-5; a code pattern is estimated by the code pattern estimation section 7-6 based upon the result of this comparison; and bit strings are reconstructed by the bit string reconstruction section 7-7 based upon the result of this estimation, and are outputted as the decoded information 7-8.

Please, replace Paragraph [00126] with the following paragraph rewritten in amendment format:

[00126] The positional deviation amount detection section 7-3 detects the amount of positional deviation between the two-dimensional image which has been coded and the ~~photographed image~~ imaging device.